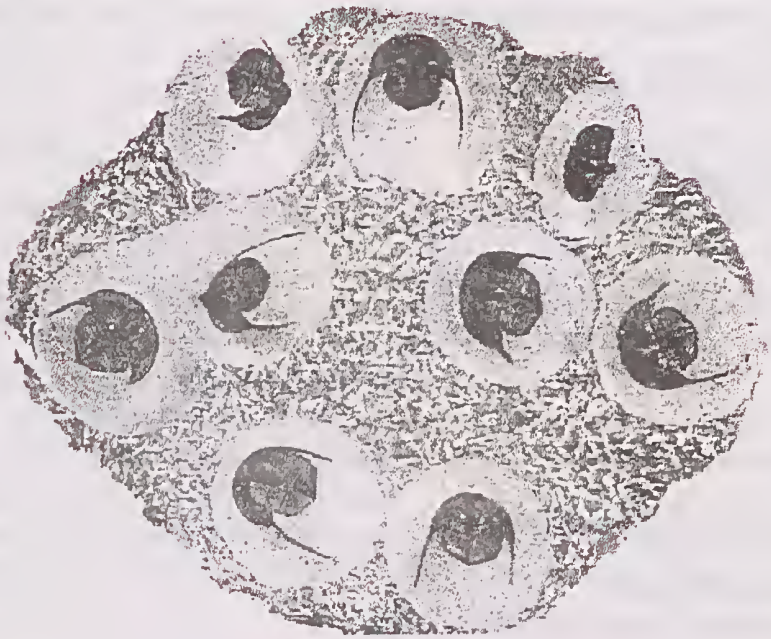
THE FOSSIL COLLECTOR

BULLETIN No. 53 JANUARY 1998



Onnia superba, Ordovician, Bordj, Morocco.
Image courtesy Larry Solomon. See Page 12.

Published by
THE FOSSIL COLLECTORS' ASSOCIATION OF AUSTRALASIA
ISSN 1037-2997

THE FOSSIL COLLECTORS' ASSOCIATION OF AUSTRALASIA

Taxonomic Disclaimer

This publication is not deemed to be valid for taxonomic purposes [see article 8b in the *International Code of Zoological Nomenclature* 3rd edition 1985. Eds W. D. Ride et al].

CONTENTS

THE EARLY CRETACEOUS (BARREMIAN-APTIAN) FLORA OF THE BINNS ROAD QUARRY OTWAY RANGES, VICTORIA

Anne-Marie Tosolini, Anthony Vadala & Stephen McLoughlin.
School of Botany, University of Melbourne. Parkville, Victoria. 3052.

Victoria is endowed with the most continuous succession of Early Cretaceous floras of any part of Australia, these Cretaceous floras are significant for several reasons. They are useful for biostratigraphic subdivision of the mainly non-marine sequence, the fossilised plant remains contributed to the coal deposits once mined near Wonthaggi in Gippsland, and the fossils help us to understand the nature of ancient high latitude forests for which there are no modern analogues. The partially degraded plant remains probably also contributed to the oil and gas reserves now exploited in the Gippsland and Otway Basins. The fossil assemblages are also significant in showing the decline of several previously widespread and abundant gymnosperm groups from the Australian biota (Bennettitales, Pentoxylales, cheirolepidacean conifers, ginkgophytes, and sphenophytes) and the first appearances of some new groups, most notably the flowering plants. This article illustrates some of the fossils recently recovered during a field trip to the Binns Road Quarry in the Otway Ranges, southwestern Victoria.

GEOLOGICAL RESEARCH INTO THE AREA

The geology of the Otway Ranges was first described by Wilkinson (1865), Krause (1874) and Murray (1877). Edwards (1962) provided the first modern interpretation of the geology and Dettmann (1963) described the fossil palynofloras of the area as part of a broader palynological survey of southeastern Australian Mesozoic strata.

The rocks at Binns Road Quarry are part of a limited outcrop of Lower Cretaceous (c. 145-131 Ma) non-marine sedimentary rock (The Otway Group) whose northernmost extent is in an approximately straight line from Lower Gellibrand in the southwest to Wensleyvale in the northeast of the Cape Otway region. These rocks were once regarded as Jurassic (c. 208-145 Ma) in age until the 1950s and 60s, when the work of Cookson (1954), Cookson & Dettmann (1958a, b),

Dettmann (1963), and Dettmann & Playford (1969) demonstrated a Lower Cretaceous age, based mainly on palynological evidence.

Douglas (1969, 1973) carried out a biostratigraphical subdivision of the Otway Ranges and other Victorian Mesozoic strata as part of a very important survey of the state's Mesozoic macrofloras. This work developed the concept of four biostratigraphical zones (Zones A to D) for these sediments. Zone A floras, of latest Jurassic to earliest Cretaceous age were found only in sub-surface strata intersected by boreholes in the Casterton area. Zone B floras (of Neocomian age) are best represented in the Boola Boola Forest region north of Traralgon, in Gippsland. Zone C floras (Barremian-Aptian age) are widely represented in outcrops through southern Gippsland and the Otway Ranges. Zone D floras (Albian age) occur in outcrops on the western side of the Otway Ranges and in the Casterton region of western Victoria (Figure 1). The sediments at Binns Road Quarry contain a macroflora that identifies them as Douglas' Zone C.

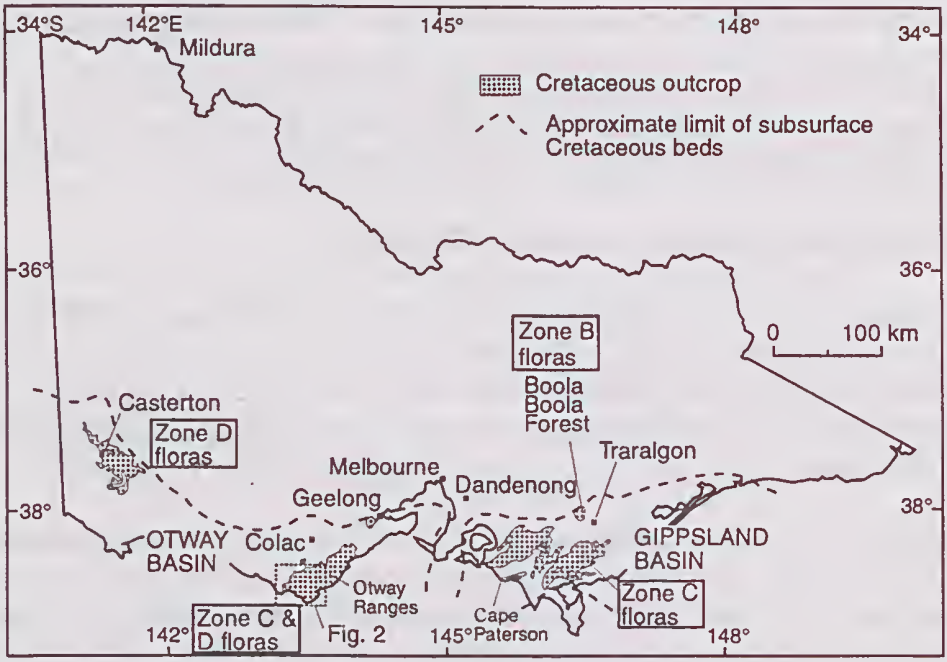


Figure 1. Distribution of Cretaceous sedimentary rocks in Victoria (after Douglas et al., 1988).

GEOLOGICAL SETTING OF BINNS ROAD QUARRY

The uplifted and eroded Cretaceous rock of the Otway Group form the rugged terrain of the Otway Ranges, the same rocks occur in the sub-surface over most of the Bellarine Peninsula and probably under the southern part of Port Phillip. They are overlain by 116-1600 m of Cenozoic sediments and volcanic rocks in these areas, and consist of non-marine sandstones, conglomerates and minor siltstones, mudstones and thin coals. The Binns Road Quarry occurs in the southwestern part of the Otway Ranges approximately 30 km by road from Apollo Bay (Figure 2).

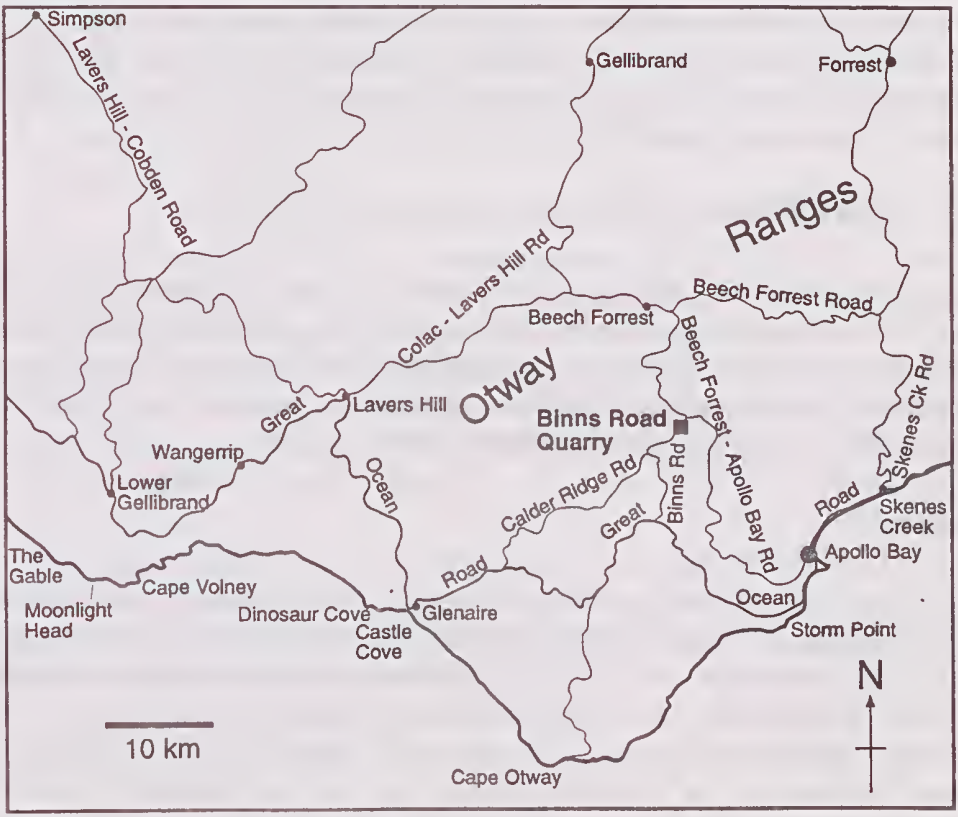


Figure 2. Location of the Binns Road Quarry.

Immediately to the north of the Cretaceous exposures in the Otway Ranges is a band of two types of younger, Tertiary marine and non-marine sediments. The first (Palaeocene to Oligocene, c. 65-35 Ma) occurs in a band from Princetown to Colac, the second (upper Miocene to lower Pliocene, c. 10-5 Ma) extends from Colac to Connewarre.

THE QUARRY ROCKS

Although the Otway Group is predominantly composed of course-grained, cross-bedded sandstones, the rock sequence in the quarry is atypical in being dominated by alternating dark mudstones and siltstones with just a minor component of interbedded feldspathic sandstones, the sandstones are greenish-grey and very fine to medium grained. The more fossiliferous mudstones and siltstones are flat-laminated but when struck they often break into conchoidal of irregularly fractured blocks. The quarry rock is intermittently used for road gravel.

THE FOSSIL FLORA OF THE BINNS ROAD QUARRY

The entire Otway coast features many localities at which Cretaceous fossils are found. These fossils include plant leaves and fruits, pollen and spores, conifer wood, dinosaur bones, plesiosaur and lungfish teeth, dinosaur footprints, and pterosaurs. The following list includes only those plants found in the Binns Road Quarry during a recent collecting expedition to the site.

Bryophytes

At least two different species of thalloid liverworts are preserved in the Binns Road Quarry sediments. They are surprisingly abundant along bedding planes and this site probably represents one of the most prolific fossil liverwort bearing localities anywhere in the world. Liverworts are primary colonisers of bare ground, which indicates that the ancient river flats and lakes dried up occasionally, leaving exposed surfaces for the liverworts to grow on. The most abundant species has large thallus segments with a prominent central thickening. The second species has smaller lamina segments that often terminate in club shaped reproductive organs (Figure 3a).

Ferns

Two representatives of the Osmundaceae family were collected from the quarry but both species are rare. A species of *Cladophlebis* has a bipinnate frond that is usually broken up into individual pinnae (Figure 3b). The pinnae have a large prominent rachilla and each elongate pinnule has a relatively straight midvein and an acute to rounded apex, secondary veins are acute and occasionally dichotomise before the margin. *Phyllopteroides serrata* has large elliptical pinnules with a robust midvein and acute bifurcating secondary veins terminating at a finely serrate margin (Figure 3c).

Sterile pinnae of *Sphenopteris warragulensis* (Figure 3f) are common in the samples collected from the Binns Road Quarry. The frond is bi- or tri-pinnate, and the alternate pinnules are elongate and oval spathulate, and often decurrent on the rachis. *Sphenopteris travisi* is distinguished by its shorter, rhomboidal pinnules with a serrate apex (Figure 3e).

Aculea bifida is probably the most abundant vascular plant in the assemblage. It has bi- or tri-pinnate fronds (Figures 3i, 4c, g), the rachis and pinna segments are extremely slender and narrow, the pinnae attach at a very acute angle and are very closely spaced on the rachis, pinnules also diverge at a very acute angle and have needle like apices. Abundant fertile fronds of this species were also found (Figure 3g), they are the same shape as sterile leaves except for a swelling at the pinnule apex that represents a sporangial cluster.

Several unidentified ferns were also collected. These include delicate, minute, fan shaped fronds with slender leaflets (Figure 3d) somewhat similar to *Aculea bifida*. Several delicate croziers from the tips of unidentified fern fronds are also represented in the assemblage (Figure 3h).

"Seed Ferns"

Taeniopteris daintreei leaves (Figure 4e) were found concentrated along certain bedding planes but were overall a rare component of the fossil flora. The leaves are elongate spathulate with entire to irregularly lobed margins and rounded or

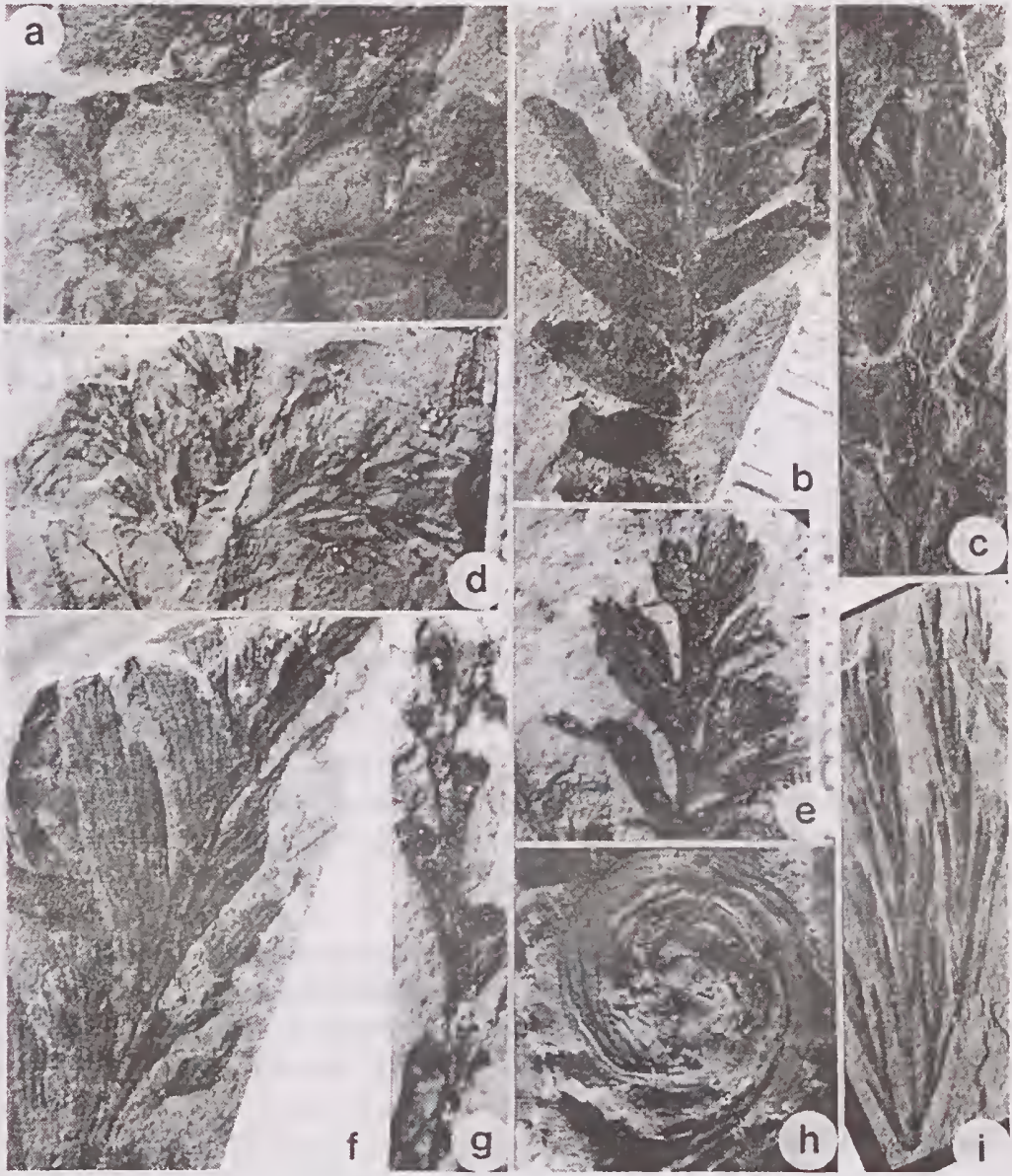


Figure 3. a, branched thalloid liverwort with terminal club shaped reproductive organs, x3; b, *Cladophlebis sp.*, x3; c, *Phyllopteroides serrata*, x1.5; d, delicate fern with fan shaped frond, x4; e, *Sphenopteris travisi*, x4; f, *Sphenopteris warragulensis*, x2; g, fertile *Aculea bifida*, x5; h, fern crozier, x5; i, sterile *Aculea bifida*, x2.

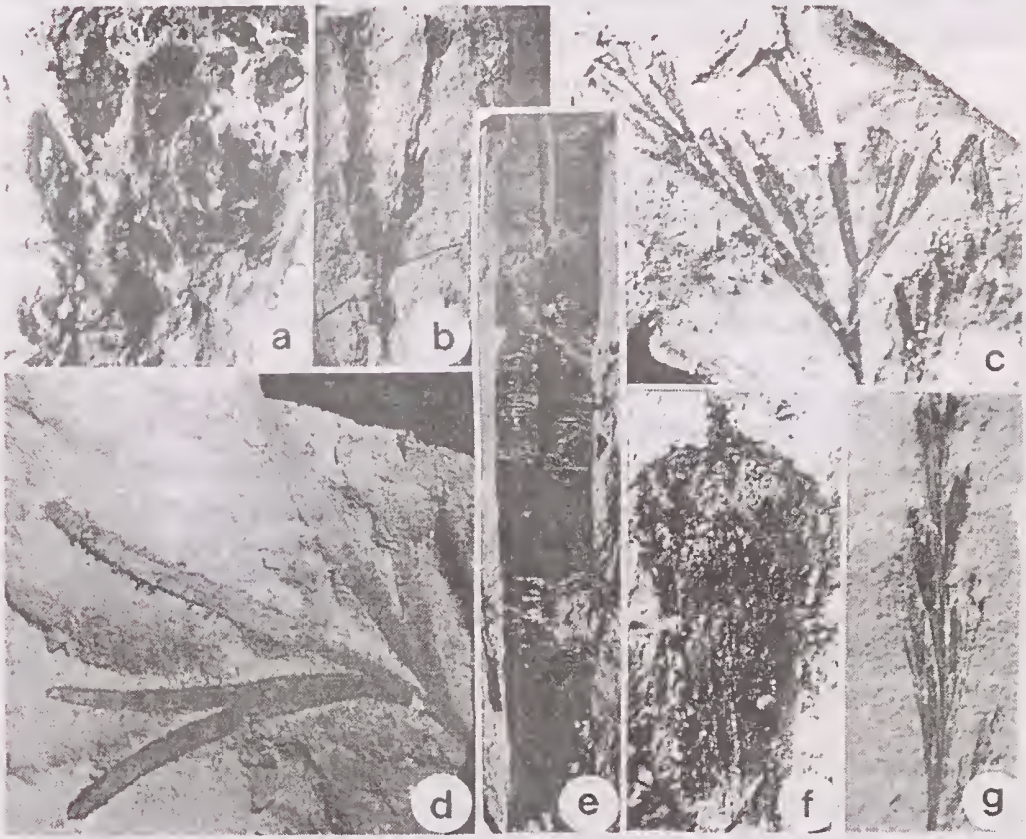


Figure 4. a, an Araucarian conifer with overlapping dark awl shaped leaves, x4; b, scale leafed conifer, x2; c, *Aculea bifida* showing spreading frond, x3; d, *Ginkgoites australis* from Gippsland, x1.5; e, *Taeniopteris daintreei*, x2; f, Araucarian cone scale, x3; g, close up of *Aculea bifida* frond segment, x3.

acuminate apices, the midrib is stout; secondary veins are perpendicular to the main mid vein, and frequently fork close to their bases.

Ginkgophytes

Ginkgo species have been found in the Otway area, however, none were collected from Binns Road Quarry. These *Ginkgo* leaves are flabellate, and deeply dissected

to their base. Similar specimens of *Ginkgoites australis* have been collected from Gippsland, one of which is illustrated in Figure 4d.

Conifers

Foliage of araucarian conifers (Figure 4a) is extremely rare at the quarry, however, araucarian cone scales are sporadically represented (Figure 4f). The cone scales are small (<2 cm) and elongate with a hardened, thickened apex usually with a terminal spine. A few other conifer remains are present but these are generally poorly preserved, a possible scale leafed conifer twig is illustrated (Figure 4b).

THE PAST ENVIRONMENT AT THE QUARRY

The bulk of the Otway Group sediments were deposited in high energy channel environments within extensive braided river systems that developed in southern Victoria following the initiation of rifting between Australia and Antarctica during the Early Cretaceous. The rocks at Binns Road Quarry are mostly composed of finer grained sediments deposited in lake environments within extensive flood plains between the major channel tracts. Some pale clay rich bands within the sequence may also represent thin ash deposits from regional volcanism.

In most parts of the Otway Group the fossil floras are dominated by conifers and other gymnospermous plants. The Binns Road flora, by contrast is rich in ferns and liverworts, probably reflecting the character of the swamp vegetation that fringed the ancient lake setting. Less abundant and often fragmentary remains of conifers in the assemblage are probably representative of plants that grew on better drained sites on the ancient alluvial plain. Many of the conifers were very tall, as evidenced by large silicified tree trunks and coalified logs found at Cape Patterson, Cape Volney, Balook and various other localities. The Early Cretaceous forests of Victoria flourished in regions that would currently be described as polar (>70° S), according to palaeomagnetic determinations for the period, and some of the fossil woods display well defined growth rings. Sub-dominant elements in these cool, high latitude forests included a range of "seed ferns", smaller conifers, and true ferns.

The other distinctive feature of the Binns Road flora is the abundance of thalloid

liverworts, the fossil liverworts are often preserved as thick mats on bedding planes and are indicative of repeated exposure of the sediment surface allowing colonisation by opportunistic bryophytes.

References

Cookson, I. C., 1954: A palynological examination of No. 1 bore Birregurra, Victoria. *Proceedings of the Royal Society of Victoria*, 66, pp. 119-128.

Cookson, I. C. and Dettmann, M. E., 1958a: Cretaceous 'megaspores' and a closely related megaspore from the Australian region. *Micropalaeontology*, 4, pp. 39-49.

Cookson, I. C. and Dettmann, M. E., 1958b: Some trilete spores from Upper Mesozoic deposits in the eastern Australian region. *Proceedings of the Royal Society of Victoria*, 70, pp. 95-128.

Dettmann, M. E. and Playford, G., 1969: Palynology of the Australian Cretaceous: a review, in Stratigraphy and Palaeontology: Essays in Honour of Dorothy Hill. Ed. K. S. W. Campbell, Canberra.

Dettmann, M. E., 1963: Upper Mesozoic microfloras in well cores from Woodside and Hedley, Victoria. *Proceedings of the Royal Society of Victoria*, 71, pp. 99-105.

Douglas, G. J., Abele, C., Benedek, S., Dettmann, M. E., Kenley, P. R., Lawrence, C. R., Rich, T. H. V., Rich, P. V. 1988. Mesozoic. In "Geology Of Victoria". Eds. J. G. Douglas & J. A. Ferguson. Ch. 7, pp. 213-250. Geological Society of Australia, Victorian Division: Melbourne.

Douglas, G. J., 1969: The Mesozoic Floras of Victoria. Parts 1-2. *Geological Society of Victoria Memoir* 28.

Edwards, A. B., 1962: Notes on the geology of the Lorne district, Victoria. *Proceedings of the Royal Society of Victoria*, 75, pp. 101-119.

Krause, F. M., 1874: Report, Cape Otway district. Appendix A. *Report Program Geological Survey of Victoria*, 1, pp 99-107.

Murray, R. A. F., 1877: Report on the geology of portions of the Cape Otway district. *Report Program Geological Survey of Victoria*, 4, pp. 11-12.

TRILOBITES OF MOROCCO

by Larry Solomon

The FCAA would like to thank Joe Small, the Editor of *Fossil News - Journal of Amateur Paleontology* and Larry Solomon for permission to reproduce the following article, which first appeared in *Fossil News - Journal of Amateur Paleontology*: Volume 2, Number 8, August 1996.

The trilobites of Morocco come from the Anti-Atlas Mountains, which span the country from southwest to northeast, from Tiznit to Erfoud. The fossiliferous trilobite exposures range in age from the Cambrian to Devonian, although there seems to be a conspicuous lack of specimens from the Silurian. The earliest fossils come from the southwestern exposures, but the best specimens are from the northeastern localities, near Alnif and Erfoud.

The preservation of the finest of these fossils is superb and, when they are prepared by an expert, their detail and completeness never fails to astonish, they are breathtakingly beautiful fossils. The size range is also amazing, from one centimetre specimens like *Thysanopeltella* to much larger specimens like *Acadoparadoxides* , which can reach lengths of fifty centimetres. The Cambrian forms, which include the ancient *Fallotaspis*, are the oldest in the world. The trilobite authority, Klaus Sdzuy, believed that they predated the Siberian *Fallotaspis*, considered to be the oldest trilobites, and named them *Eofallotaspis* (Sdzuy, 1988). Some believe that they may extend into the Precambrian, Vendian Period, especially those found in the western sections, near Tiout (see Trilobite Mysteries, later in this article).

Considering the wealth of species that have been collected from the Anti-Atlas Mountains, it must be considered one of the best and most important sources of well preserved trilobites in the world, and possibly the most diversified in species. There is the huge and elegant *Acadoparadoxides* from the early Cambrian, which, like its *Olenellid* cousins, looks as if its streamlined, hydrodynamic body is swimming on the rock. There is the blind, eyeless Ordovician *Onnia* with its mysterious ornate and beautiful cephalic fringe and with genal spines twice as long as its body. Pits in the cephalic fringe of *Onnia* have been determined to actually be tiny tapered cylinders that are believed to have been used for filter feeding.

Onnia, like other trinucleids, probably carved out a depression in the sea floor and faced the current to feed.

The Devonian species are the most elaborate, spiny forms that have ever been seen, many of them preserved with all of their spines intact. *Dicranurus monstrosus* is an apt name for this bug-eyed monster with not just spines, but with antlers that resemble those of an elk, it is truly amazing to see its form preserved in such detail. The variety of Moroccan forms is astonishing, among them are the fan-tailed *Scutellum* and delicate *Kolihapeltis*, the moon shaped *Harpes*, and tank-like *Paralejurus*. Even more miraculous was the incredibly ornate *Philonyx* with its multifaceted, spiny schizochroal eyes, forked glabella extension, and forest of body spines, there is also the spectacular, multi-antlered and spiny *Ceratarges* and the elegant *Psychopyge*. Another, *Phacops megalomanicus*, was a bulky tuberous type with large compound, schizochroal eyes that were sometimes preserved in amazing detail, *Phacops* is well known in a variety of species found in the United States, but of much smaller size

I don't know of any other source in the world, for these spiny trilobites, where they are preserved in such detail, looking as real as if they were still alive (when prepared by an expert), they are incomparable and unsurpassed. The only other trilobite source that currently produces anything similar is the Devonian Harragan Formation in Oklahoma, U.S.A., which is more limited in species and age, but rivals some of the Moroccan forms in fineness of detail.

More and more Moroccan trilobites are still being discovered, and most of them are undescribed, their numbers are staggering. The accompanying table (see pages 14-15) contains a sample of many that have been collected in complete or nearly complete form.

TRILOBITE MYSTERIES

The trilobites are among the oldest of the metazoans (multicellular animals with differentiated tissues and organs), in fact, they are the oldest with complex sensory organs, e.g., compound eyes, jointed legs, antennae, etc. Also, for being one of the earliest organisms they were also incredibly complex, with a brain, nervous system, digestive tract, and muscular system. This, in itself is astounding, but when

MOROCCAN TRILOBITES

Genus	Species	Author	Age	Frm	Freq	Location
Acadoparadoxides	*mureroensis*	Sdzuy	Cam		rare	Sidi Ab.
Acanthopyge	*sp.*		m/Dev	Hamar	v rare	Hamar
Acastoides	*hollardi*	Alberti	Dev		v rare	Alnif z
Andalusiana	*sp.*	Sdzuy	e/Cam		com	Ougrat
Actinopeltis	*sp.*	H&C	l/Ord	Ktaoua	x rare	Bordj
Asteropyge	*sp.*	H&C	Dev	Hamar	v rare	Mt. Issomour
Bailiella	*levyi*	Bergeron	Cam		com	Sidi Ab.
Bigotina	*sp.*	Cobbold	e/Cam		x rare	Tiout
Breviscutellum	*sp.*	Snajdr	Dev		v rare	Alnif
Calymenella	*sp.*	Bergeron	l/Ord	Ktaoua	v rare	Bordj
Ceratarges	*sp.*	Guerich	m/Dev	Hamar	x rare	Alnif z
Chryphina	*sp.*	Oelert	e/Dev	Hamar	x rare	Alnif z
Cornuproetus	*sp.*	Richter	m/Dev		rare	Alnif
Cretalusse	*falus*		Dev			
Crotalocephalina	*globifroms*	H&C	Dev	Hamar	v rare	Erfoud z
Ctenocephalus	*bergeroni*	Thoral	Cam		rare	Sidi Ab.
Diacalymene	*ouzregui*	Destombes	e/Ord	Ktaoua	v com	Tazoulait
Dicranurus	*monstrosus*	Barrande	e/Dev	Megrane	v rare	Oulmes
Eremiproetus	*frequens*	Alberti	Dev	Hamar	rare	N Tafilalt
Fallotaspis	*typica*	Hupe	e/Cam		v rare	SUD
Flexicalymene	*tazarinesis*	Destombes	l/Ord	Tiouririne	rare	Maider
Harpes	*venulosus*	H&C	Dev	Mergel	rare	Erfoud z
Harpides	*sp.*	Beyrich	e/Ord		x rare	Taouz
Illaenus	*sp.*	Dalman	Ord	Ktaoua	com	Zagora
Kolihapeltis	*rabatensis*	Alberti	Dev	Hamar	x rare	Tafilalt
Koneprusia	*brutoni*	Alberti	Dev	Hamar	rare	Erfoud z
Lannacus	*sp.*	Tjernvik	e/Ord		com	Taouz
Leonaspis	*pigra*	Barrande	Dev	Hamar	rare	Alnif z
Leonaspis	*hastata*	Alberti	m/Dev		x rare	Alnif
Marocanitis	*sp.*		m/Dev	Hamar		Hamar
Megalaspides	*sp.*	Brogger	e/Ord		s com	Taouz
Metacanthina	*barrandei*	Oehlert	Dev		rare	Alnif
Neometacanthus	*sp.*	Richter	Dev	Hamar	s com	Erfoud z

Abbreviations: H&C = Hawle & Corda, e = early, m = middle, l = late, s = somewhat, com = common, v =v ery, x = extremely, Sidi Ab = Sidi Abdallah ben el Hadj, Hamar = Hamar Lagdad, z = zone.

MOROCCAN TRILOBITES cont

Genus	Species	Author	Age	Frm	Freq	Location
Odontochile	*spiniferum*	H&C	Dev	Hamar		Alnif
Onnia	*superba*	Bancroft	Ord		s com	Bordj
Otarion	*tafilaltense*	Alberti	Dev	Hamar	rare	Erfoud z
Parahomolatonus	*sp.*	Reed	e/Dev		s com	Tazilouait
Paralejurus	*dormitzeri*	Barrande	e/Dev	Hamar	v rare	Tafilalt
Phacops	*megalomanicus*	Struve	Dev		com	Alnif
Phacops	*speculator*	Alberti	m/Dev		s com	Alnif
Pharostoma	*sp.*	H&C	Ord		s com	Taouz
Philonyx	*philonyx*	Richter	e/Dev	Hamar	x rare	Alnif z
Platyscutellum	*tafilaltense*	Alberti	Dev	Hamar	v rare	Alnif z
Proetus	*granulosis*	Goldfuss	Dev		com	Alnif
Psychopyge	*elegans*	Termier	e/Dev	Hamar	x rare	Alnif z
Reedops	*maurulus*	Alberti	Dev	Tiftel	s com	Tiftel
Scabriscutellum	*hamlagdadianum*	Alberti	e/Dev	Hamar	v rare	Hamar
Scutellum	*pustulatum*	Barrande	e/Dev	Hamar		Hamar
Selenopeltis	*buchii*	Barrande	l/Ord		v rare	Erfoud z
Selenopeltis	*sp.*	H&C	l/Ord	Ktaoua	x rare	Bordj
Thysanopeltis	*speciosa*	H&C	e/Dev	Hamar	x rare	Hamar
Treveropyge	*sp.*	Struve	Dev	Hamar	s com	Alnif z
Tropidocoryphe	*hamlaghdadica*	Alberti	Dev	Hamar	x rare	Hamar

Abbreviations: H&C = Hawle & Corda, e = early, m = middle, l = late, s = somewhat, com = common, v =v ery, x = extremely, Sidi Ab = Sidi Abdallah ben el Hadj, Hamar = Hamar Lagdad, z = zone.

combined with the fact that they had no known evolutionary predecessors, it becomes ones of prehistory's greatest mysteries. Trilobites were strictly marine animals that first occurred at the base of the Cambrian and became part of what is called the "Cambrian explosion", an apparent diversification of life that knows no comparison with any period since then. Until fairly recently, it was thought that trilobites were among the very first fossils, since no undisputed forms were known in the Precambrian. Today, a wide variety of simple plants and animals have been accepted as fossils in late Precambrian rocks, but, still nothing as complex as the trilobite. Scientists believe that they must have had a hidden period of evolution.

So, from where they came is still a mystery. Recently, soft-bodied trilobites were discovered in rocks deposited in the Vendian (late Precambrian) period, this

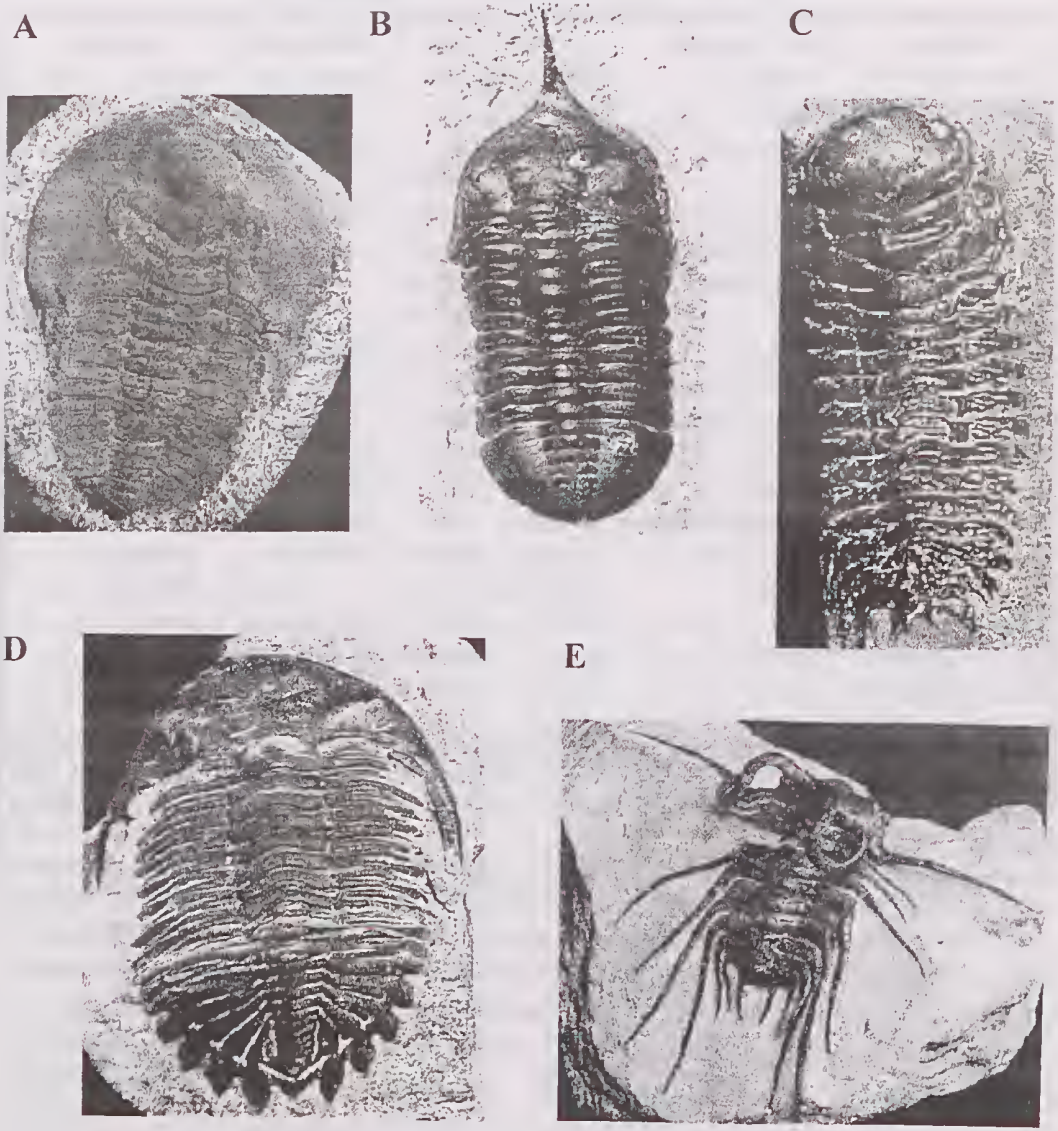


Figure 1. A. *Andalusiana sp.*, Early Cambrian, Ougrat, 9.4 cm; B. *Marocanitis sp.* Middle Devonian, Hamar, 7.6 cm; C. *Cretalusse falus*, Devonian, 6 cm; D. *Neometacanthus sp.*, Devonian, Hamar, 6.4 cm; E. *Dicranurus monstrosus*, Early Devonian, Oulmes, 6.4 cm.

corroborates the trilobite tracks that have also been discovered from the Vendian to Early Cambrian (Crimes, in Lipps, 1992). Most animal fossils are a record of their hard parts, it is probable that these soft-bodied trilobites were not often fossilised because of their lack of hard parts, this would account for the trilobite's "hidden evolution". There is no firm evidence for hard shelled animals prior to the Cambrian, except for the polyps *Cloudina* and *Sinotubulites*, hard shells were primarily a Cambrian development. This could mean that the "Cambrian explosion" is an artefact, since hard shells made fossilisation much more possible, and soft bodied form are rarely preserved in any period.

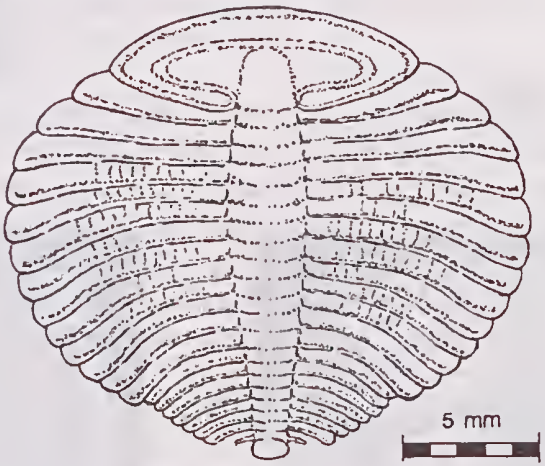


Figure 2. Soft Trilobite, Ediacara Formation, Flinders Ranges, South Australia, (from Jenkins in Lipps, 1992).

The Vendian trilobite discovery could have important repercussions for theories of evolution. Stephen Jay Gould has proposed the "punctuated equilibrium" theory to replace the older model of uniformitarianism, a gradual evolution over long periods. Gould contended that because the occurrences of soft-bodied fossils from the Vendian (Ediacara) period contained no record of trilobites and other Paleozoic metazoan ancestors, and that because they are of worldwide distribution (i.e. not just a fluke), they do not support the model of uniformitarianism. Further, he stated that "The beginning of the Cambrian is **not** marked by the appearance of

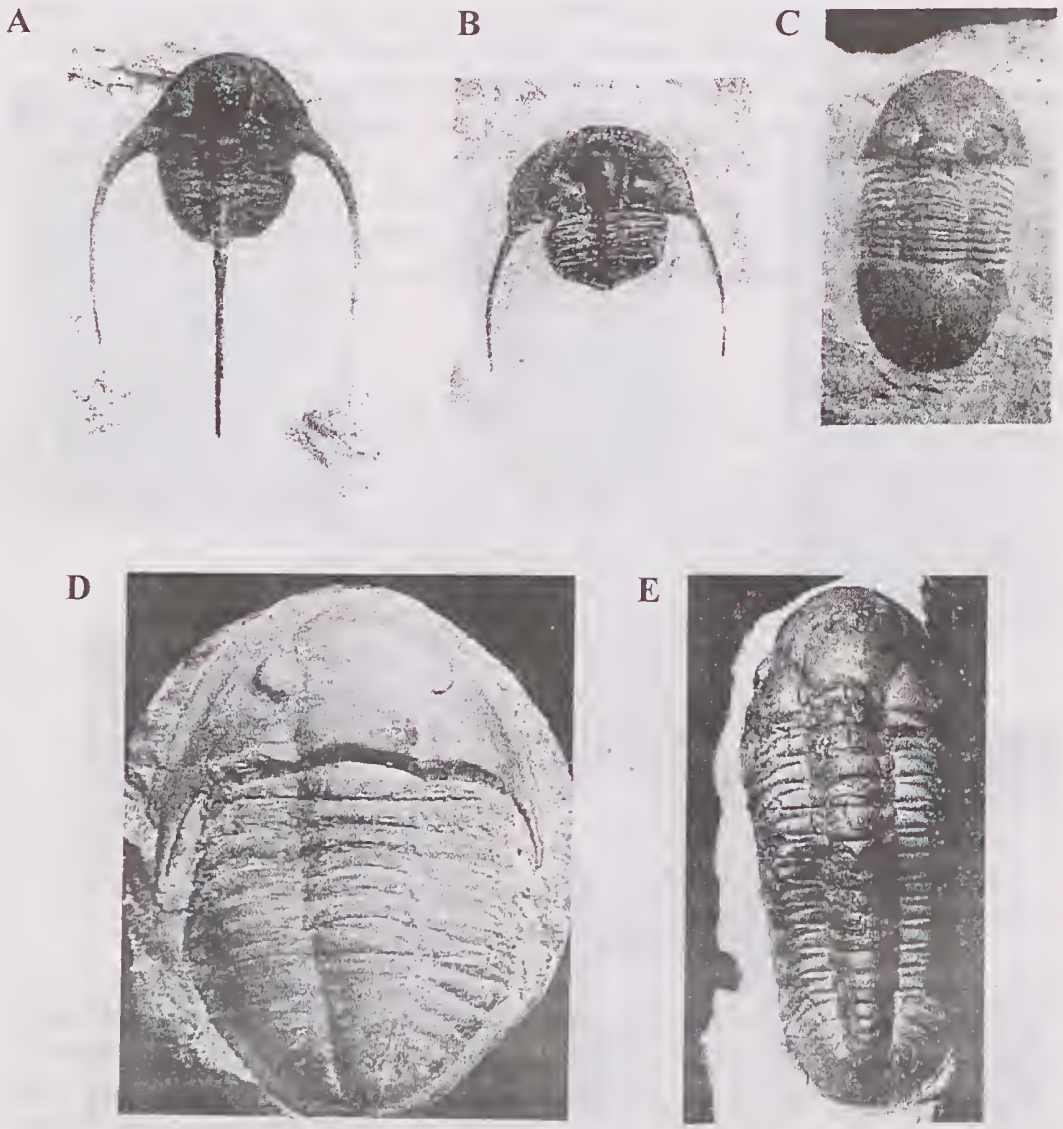


Figure 3. A. *Otarion tafilaltense*, Middle Devonian, Alnif, 4 cm; B. *Onnia superba*, Ordovician, Bordj, 2.5 cm; C. *Paralejurus dormitzeri*, Early Devonian, Tafilalt, 2.5 cm; D. *Megalaspides sp.*, Late Ordovician, Taouz, 6.5 cm; E. *Reedops maurulus*, Devonian, Tiftel, 5 cm.

trilobites" (Gould, 1989, p. 59). He cited the Tommotian of Russia as containing earlier Cambrian fossils with hard, shelly parts, but no trilobites, which he assumed did not appear until later, he then used this to support his model of the "Cambrian explosion". It seems that these statements will have to be revised in light of the recent evidence of trilobites from pre-Tommotian times, the Vendian precedes the Tommotian of the Early Cambrian and is considered to be Late Precambrian. Thus, the tiny Tommotian fauna were not "later supplanted by trilobites and their cohort in the final pulse of the Cambrian explosion", as Gould stated. The evidence suggests that non-shelled trilobites lived during the Precambrian and developed hard shells at the beginning of the Cambrian, and therefore became more capable of fossilisation. This, in turn, suggests that the "Cambrian explosion" is an artefact, at least with respect to the trilobites.

Other mysteries pertain to the trilobite's own evolution. The early Cambrian forms were elegant and beautifully simple in structure, far from looking embattled, these species give the impression of a free and easy life. They are the most abundant and dominant fossils from the Cambrian period. But they must have encountered growing competition to have had to develop the increasingly specialised form that came later. By the Devonian some of them had become quite bizarre, with complex spines, antlers, and other armour which was probably meant for defence.

One of the most amazing specialised developments was the trilobite's compound schizochroal eye. Its structure is different from the holochroal eye, which is common among the insects, other arthropods, and early trilobites, the schizochroal eye is unique to trilobites of the suborder Phacopina (Levi-Setti, 1993). Each lens is separately encased and each is covered by its own cornea, further, each lens was made of calcite, a birefringent crystal of calcium carbonate (It bends light in two different directions). It would seem to be an unsuitable material to focus images in the trilobite's environment, but, each crystal was aligned in exactly the right way to avoid a double image. Even more astonishing, the trilobite developed a compound lens that corrected spherical aberrations, a doublet lens of two materials cemented along a bowl-shaped dividing line. This type of lens was not known to man until Descartes and Huygens described it in the seventeenth century, the trilobites developed it over 500 million years earlier! The compound, doublet lens is still used for correcting optics today, but, in the animal kingdom it became extinct with the trilobites.

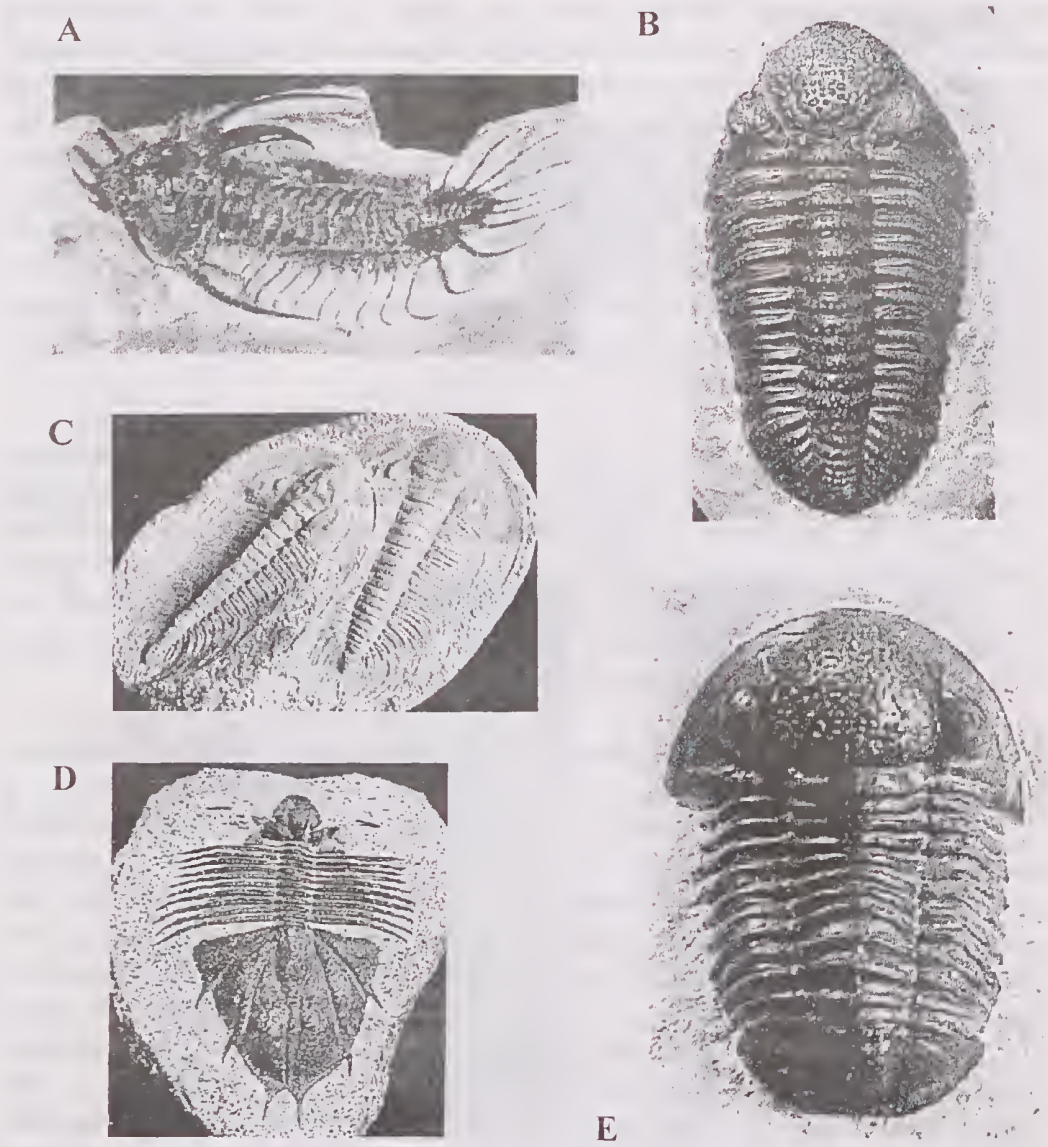


Figure 4. A. *Philonyx philonyx*, Devonian, Alnif, 7 cm; B. *Phacops megalomanicus*, Devonian, Alnif, 15 cm; C. *Acadoparadoxides mureroensis*, Early Cambrian, Mt Ougnat, 25 cm; D. *Acanthopyge sp.*, Middle Devonian, Hamar, 9.4 cm; E. *Proetus granulosus*, Devonian, Alnif, 3 cm.

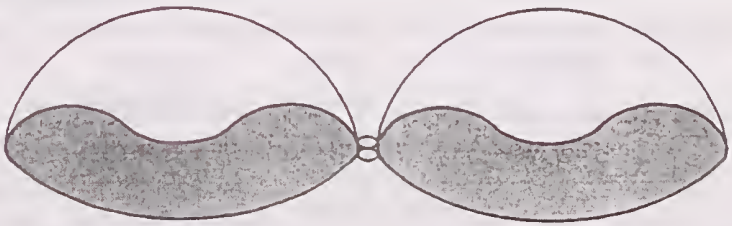


Figure 5. The trilobite's schizochroal eye, showing the doublet lens which corrected spherical aberration.

In spite of these marvellous developments, the trilobite's inevitable, long decline was only prolonged during the Carboniferous period, during this time their antlers and spines disappeared, and they reverted to simple forms again. It seems that the specialist trilobites had become over specialised, no longer able to adapt to the changes that were taking place around them, threatening their existence. They were no longer the graceful, large forms found in the Cambrian, nor were they the elaborately ornamented shapes of the Devonian, but plain, small, and defensive, declining in number and in function.

Trilobites, an entire class of animals in the largest phylum of animals on Earth, the arthropods, became extinct by the end of the Permian. They had wandered the world for approximately 300 million years and developed about 1,500 genera and over 10,000 species. They left the world as mysteriously as they came, what caused their extinction is their final mystery. Some believe that a huge asteroid collided with the Earth at the end of the Permian, resulting in the greatest mass extinction in the Earth's history, much greater than the collision that is believed to have caused the extinction of the dinosaurs. Others believe that deteriorating environmental

TRILOBITE TIMETABLE

ERA	Mya	PERIOD	DIVISION	TRILOBITES (examples)
PALEOZOIC	250	Permian	Late	*Delaria*
			Early	*Ditmopyge*
	290	Pennsylvanian (U. Carboniferous)	Late	*Ditmopyge*
			Early	
	320	Mississippian (L. Carboniferous)	Late	*Phillipsia*
			Early	*Phillipsia*
	360	Devonian	Late	*Scutellum*, *Ceratarges*
			Middle	*Phacops*, *Leonaspis*
			Early	*Philonyx*, *Dicranurus*
	409	Silurian	Late	*Arctinurus*
			Early	*Dalmanites*
	440	Ordovician	Late	*Cryptolithus*, *Selenopeltis*
			Middle	*Triarthus*, *Isotelus*
			Early	*Diacalymene*, *Asaphus*
	510	Cambrian	Late	*Welleraspis*, *Elrathia*
			Middle	*Ogygopsis*, *Agnostus*
			Early	*Fallotaspis*, *Olenellus*
	545			
PRECAMBRIAN				
		Vendian	Late	Soft-bodied
			Early	trilobites
	610			

Mya = millions of years ago.

conditions caused this massive extinction. Whatever the cause, estimates are that as high as 96% of all species were obliterated at the end of the Permian, never to be seen again. We know, however, that the trilobites were dying out during the Permian, and an asteroid collision may have just been the final blow.

References

Gould, Stephen Jay, 1989. *Wonderful Life, the Burgess Shale and the Nature of History.* New York: Norton.

Levi-Setti, Richardo, 1993. *Trilobites.* Chicago: University of Chicago.

Lipps, J.H., and Signor, 1992. *Origin and Early Evolution of the Metazoa.* New York: Plenum.

Moore, Raymond, 1959. *Treatise on Invertebrate Paleontology, Part O, Arthropoda 1.* University of Kansas.

Sdzuy, K. and Geyer, G. 1988. "The Base of the Cambrian in Morocco", in *The Atlas System of Morocco, Lecture Notes in Earth Sciences*, Volker H. Jacobshagen, Ed. pp 91-106. New York: Springer Verlag.

BOOKS AND BOOK REVIEWS

DINOSAURS, THE ENCYCLOPEDIA. by Donald F. Glut. Published by McFarland & Company, Inc., 1997. 1,076 pp. ISBN 0-89950-917-7. Price: US$145.00. (This book is not currently available in Australia but can be ordered through any good bookseller. Ed).

A book of 1,076 pages about dinosaurs is obviously not one for the casual reader. This book is for: 1) the dinosaur fanatic, 2) the researcher on dinosaurs (especially dinosaurian taxonomy), 3) anyone wishing entry into the scientific literature on dinosaurs, it was specifically written for the last two groups. This is not a book about how dinosaurs lived, evolved or became extinct, although there is an introductory section on these topics, but a reference work, a kind of dictionary that consists of entries under the generic names. Basically each entry 1 - shows figures of specimens of that genus, and sometimes also restorations where the specimens are adequate, 2 - gives diagnoses, where recent ones have been published, and 3 - outlines the major research done on that genus, and thus provides access to the scientific literature.

This is the book that laymen have long assumed exists, but which until now did not. The book to look at to find the basic information about any dinosaur that was described and named before 1996. Before this volume, such information was available only by searching through the scientific literature - assuming that the relevant items could be found.

Of the hundreds of genera included, only fifteen entries have no figures. The most significant feature of the book is that it not only includes many figures never before published, but also figures material never before figured - including much historically and taxonomically important material. The illustrations include line drawings and photos from the literature as well as original photos, and are almost always of high quality.

This book has entries for every genus of dinosaur proposed up to early 1996. The time at which the text was completed can be judged from the inclusion of *Irritator* (published in January 1996) and the absence of *Angaturama* (published in March). The inclusion of a section at the end of names that have been published but not described or described only in Chinese is also very useful.

The introduction reminds us of the inevitability of typographic errors and there are some, although not many. I found only three significant errors (one of which was pointed out by the author), all in figure captions: the figure on p. 99 is the holotype of *Gorgosaurus libratus*, not *Gorgosaurus sternbergi*; that on p. 289 is the femur of *Chinshakiangosaurus zhongheesis*, not the scapula of "*Chinshakiangosaurus zhongheesis*"; and that on p. 437 is not "*Geranosaurus harriesi*" but includes specimens of both *Massospondylus harriesi* and *Geranosaurus atavus* (which is only the jaw at bottom right). For a book with over a thousand illustrations, that really isn't bad.

Three books on dinosaurs should be in the library of everyone who has an interest in the subject. David Norman's *The Illustrated Encyclopedia of Dinosaurs* (1985) is the best source for the general reader, who has no background in dinosaurs. Weishampel, Dodson & Osmolska's *The Dinosauria* (1990) is the best (partly because it is the only) book on the anatomy and palaeobiology of dinosaurs, and Glut's book complements these by providing the nitty-gritty details for each genus.

Reviewed by Dr Ralph Molnar.

EDITORIAL NOTES

With the two excellent articles that appear in this issue, I thought the Editorial Notes would enjoy a holiday from its usual page 3 position, hence, here it is, seeing what life is like at the other end of *The Fossil Collector*.

I would like to ask if anyone knows what happened to 1997. I am now starting to believe the stories other people have told me about what happens to time when one becomes a parent, incredible. I guess the upside on time going by so quickly is that I might miss one or two of my birthdays along the way, and even though I pride myself with having regressed quite a few years since the birth of my daughter, the body doesn't stop ageing.

Since the issue of the last bulletin, Ayla has seen her first birthday, which I must say was a wonderfully messy event. To see six children (including Ayla) all around the same age experiencing cream, birthday cake and food in general was, well, delightful. Ayla has now also discovered walking and climbing which keeps both Julie and I on our toes not to mention looking out for where she might be hiding trying to destroy something we left lying around. All this in the name of discovery, gee, is that a grey hair I see on my balding head!!

Fossil collecting for the Tierney family has been very quiet over the last few months, where the only trip made was to the Triassic around Brisbane at which time I was lucky to find my first well preserved, and large, *Neocalamites* specimen. During the winter of last year, I made several trips to the Durikai plant locality, here in southeast Queensland. These trips have turned up some new and interesting specimens (see Page 27) which have apparently not been found before from this locality. I would like to ask readers who have collected material from Durikai to have another look at your specimens and see if they contain any seed pods or fruiting bodies. If they do, consider making a latex cast of the structure and sending the cast to me so that we can further our knowledge on the flora from this deposit. If the cast cannot be made, the specimen can be sent to me (if it is not too large) at which time I will make the cast, then send the specimen back to its owner.

It seems that the stories of despair continue. I was recently told of the time when a well respected professional palaeontologist made the time to take a group of

amateurs to a locality where some rare specimens could be found. The only request by the professional was that if any rare specimens were found (what was considered rare was pointed out), would the finder please bring it into the museum so it can be looked at. After making this request the professional then left the locality, at which time some people were heard to say "take them to the museum, not a chance, we're going to sell them," unfortunately this statement was not a joke.

While I acknowledge the greed of the almighty dollar, is this really the right way to treat a person who believes he/she can trust a group of people to do the right thing, especially for new or rare specimens. I guess my lot is to be happy with the fact that I will not be trusted by some professionals due to the actions of the minority of amateurs. There are still some professional people who think an amateur should not have a collection and try to counsel the law makers to legislate to this effect (yes I do know a person like this). I personally wouldn't like this to come about due to the actions of a few greedy people.

The deadline for material for Bulletin No. 54 is March 25, 1998.

PROBABLE *CAYTONIA* INFLORESCENCE FROM THE DURIKAI PLANT BEDS.

H. Trevor Clifford. Queensland Museum. P.O. Box 3300, South Brisbane. 4101.
Paul Tierney. 2 Mahogany Drive, Caboolture. 4510.

The flora of the Jurassic Durikai plant beds has been well documented (Rozefelds and Sobbe, 1983), but hitherto no fruiting structures have been reported from this locality. The collection, therefore of a well formed mould of an inflorescence is of interest.

The cast comprises a single unbranched axis bearing two rows of stalked, possibly ovulate, cupules, each about 2 mm in diameter (Figure 1). Such inflorescence are typical of Caytonales foliage of which *Sagenopteris nilssonii* is well represented in the Durikai flora.

Until anatomical data is available, it is suggested the cast be assigned to *Caytonia*, which if correctly identified is apparently the first record of the genus for Queensland.

References

Rozefelds, A.C. & Sobbe, I., 1983. Fossil plants of the Durikai plant beds near Warwick, south east Queensland. *The Fossil Collector*, Bulletin No. 10, pp. 15-20.

Figure 1. QMF 35881, latex cast from a mould of a presumed ovulate inflorescence of *Caytonia*, x2.

IN THE NEWS

History Hinges on Jawbone.

A tiny fossilised jawbone, 16 mm long and weighing just one gram, found on the Gippsland coast may revolutionise theories on mammal evolution. The jawbone was found in 115 million year old rocks near Inverloch, Victoria, by Melbourne palaeontologists.

It is one of the oldest mammal fossils found in the world and casts doubt on the theory that placental mammals evolved in isolation in the northern hemisphere. That theory argued that mammals did not reach the southern continents until some time after the extinction of the dinosaurs, 65 million years ago.

Dr Tom Rich, curator of fossils at the Museum of Victoria, said the teeth and jawbone of the tiny mammal confirmed it was neither a marsupial nor an egg laying monotreme. But neither was it an ancestor of modern placental mammals such as cows, dogs, rodents, whales and humans. Dr Rich and his wife, Professor Patricia Vickers-Rich, of Monash University, announced their discovery in the international research journal *Science*.

The ancient mammal has been named *Ausktribosphenos nyktos*, meaning "southern Cretaceous nocturnal mammal with tribosphenic teeth". Dr Rich said the dual action tribosphenic tooth, which could both slice and crush food, was a crucial evolutionary innovation in mammals

The jawbone confirms that tribosphenic toothed placental mammals were already present in Australia - and probably throughout the southern supercontinent of Gondwana - about 115 to 120 million years ago, 50 million years earlier than supposed.

Previously, palaeontologists believed that placental mammals and marsupials arose from a common ancestor in the northern supercontinent of Laurasia about 150 million years ago, and that placental mammals did not reach Gondwana until well into the Age of Mammals, which began when the dinosaurs became extinct. According to this theory, the only mammals in Gondwana were a now extinct group called the gondwanatheres, and egg laying monotremes related to the platypus and echidna. After Laurasia and Gondwana separated, Gondwana remained isolated until continental drift brought South America into contact with North America about 65 million years ago. At this time marsupials colonised South America, spreading to Antarctica and Australia

The Inverloch dig, which is a joint project between Monash University and the Museum of Victoria, may require researchers to rethink mammal distribution.

Report by Graeme O'Neill, Herald Sun, Friday November 21, 1997.